Space Weather Technical Forecast

Issued on Sunday, 08 October 2023 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity is Moderate with an isolated M1.7 flare observed at 07/1807 UTC, from a newly emerged sunspot region in the southeast (AR3460). Nine sunspot regions feature on the visible disc with two unnumbered. AR3451 and AR3452 in the northwest are the two largest regions. AR3451 has currently lost the delta spot in the intermediate region and the intermediate spots are showing some growth in recent hours. AR3452 is rather smaller with little overall change observed. AR3454 near south centre disc has shown minor growth recently in the trailing portion. The aforementioned AR3460 in the southeast is recently numbered growing rather quickly. It is also displaying north-south magnetic alignment The remaining regions all appear to be small and mostly simple. Whilst there have been a couple of CMEs assessed in the last 24 hours, none are expected to give significant impacts at Earth. No other Earth-directed CMEs have been observed in coronagraph imagery in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds as observed at L1 by DSCOVR and ACE have gradually declined from slightly elevated to slow-ambient levels, around 320 km/s. The solar wind density was below average and with a peak of 8 ppcc overserved at 08/0709 UTC. Total magnetic field strength has been weak. The north-south component varied weakly between +6/-5 nT. Phi angle has been positive (away from the Sun), but has recently rotated closer to negative (towards the sun) in recent hours. Geomagnetic activity has been Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was at background to moderate levels. Associated 24-hour fluence was below the Active (1e8 integrated pfu) threshold with a mostly flat trend. The observation at 07/2100 UTC was 1.14e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain at Low to Moderate levels, with the greatest chance of a further Moderate level flare probably coming from AR3451 and AR3452 in the northwest of the disc, and perhaps also from the newly emerging region AR3460 in the southeast, which has the rather unusual magnetic structure which favours enhanced flare activity.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 05 Oct may give some minor shock component on Day 2 (09 Oct). Solar winds are currently at slow-ambient levels and are expected to remain so until the High Speed Streams (HSS) of CH57/- and CH58/- arrive at Earth later on Day 2 (09 Oct) and into Day 3 (10 Oct), with elevated levels probably being achieved. However, being negative polarity coronal holes, they are not favoured for significant

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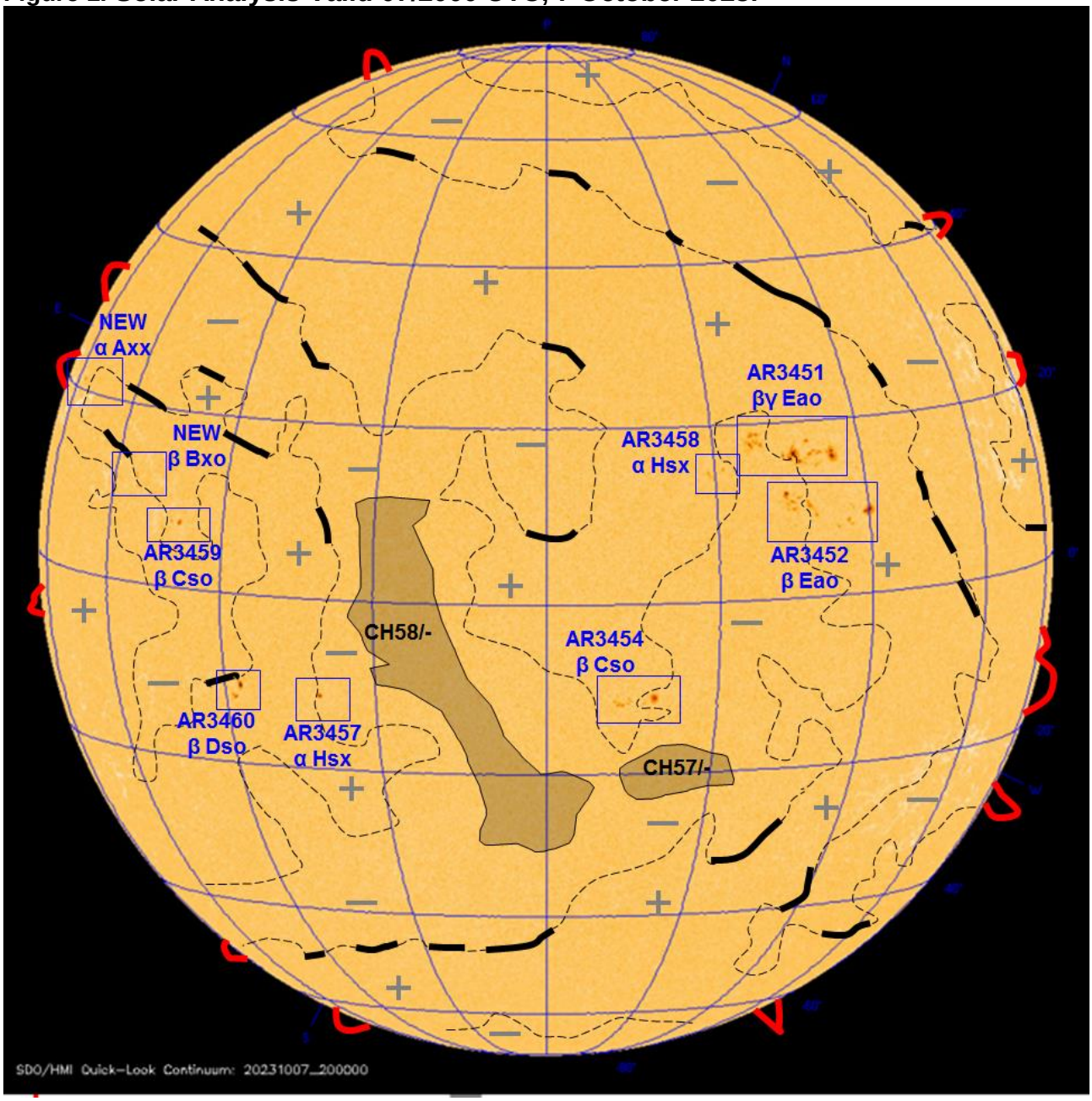
geomagnetic response at this time of year. Quiet to Unsettled geomagnetic activity is expected. There is chance of Active intervals, especially on Days 2 and 3, with a slight chance of G1/Minor storm periods, mainly due to HSS effects, on those days.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is most likely to remain at background levels, with a very low risk of enhancements mainly from AR3451 and AR3452. High energy electron flux (greater than 2MeV) is forecast to be at background to moderate levels throughout. Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 07/2000 UTC, 7 October 2023.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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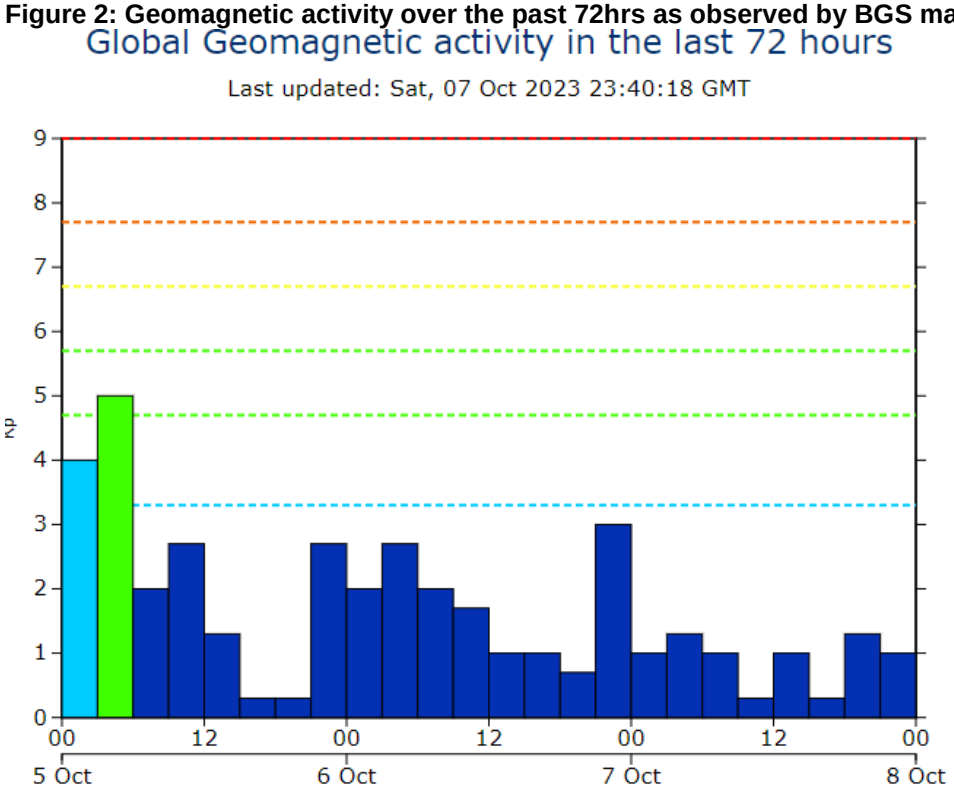
Geomagnetic Storms:

A CME which left the Sun around 05/1930 UTC is mostly directed away from Earth. Whilst there may be some shock component arriving on Day 2 (09 Oct), any impacts from this are expected to be minor. Solar winds are expected to remain at slow-ambient levels until the High Speed Streams (HSS) of CH57/- shortly followed by CH58/- arrive at Earth later on Day 2 (09 Oct) and into Day 3 (10 Oct), with solar winds perhaps reaching elevated levels. However, these are negative polarity coronal holes, which are not favoured for significant geomagnetic response at this time of year. Geomagnetic activity is expected to remain at Quiet to Unsettled levels. There is daily chance of Active intervals, with a greater probability on Days 2 and 3, and a slight chance of G1/Minor storm periods, mainly due to HSS effects on those two days.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	30	20	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Figure 2: Geomagnetic activity over the past 72hrs as observed by BGS magnetometers.



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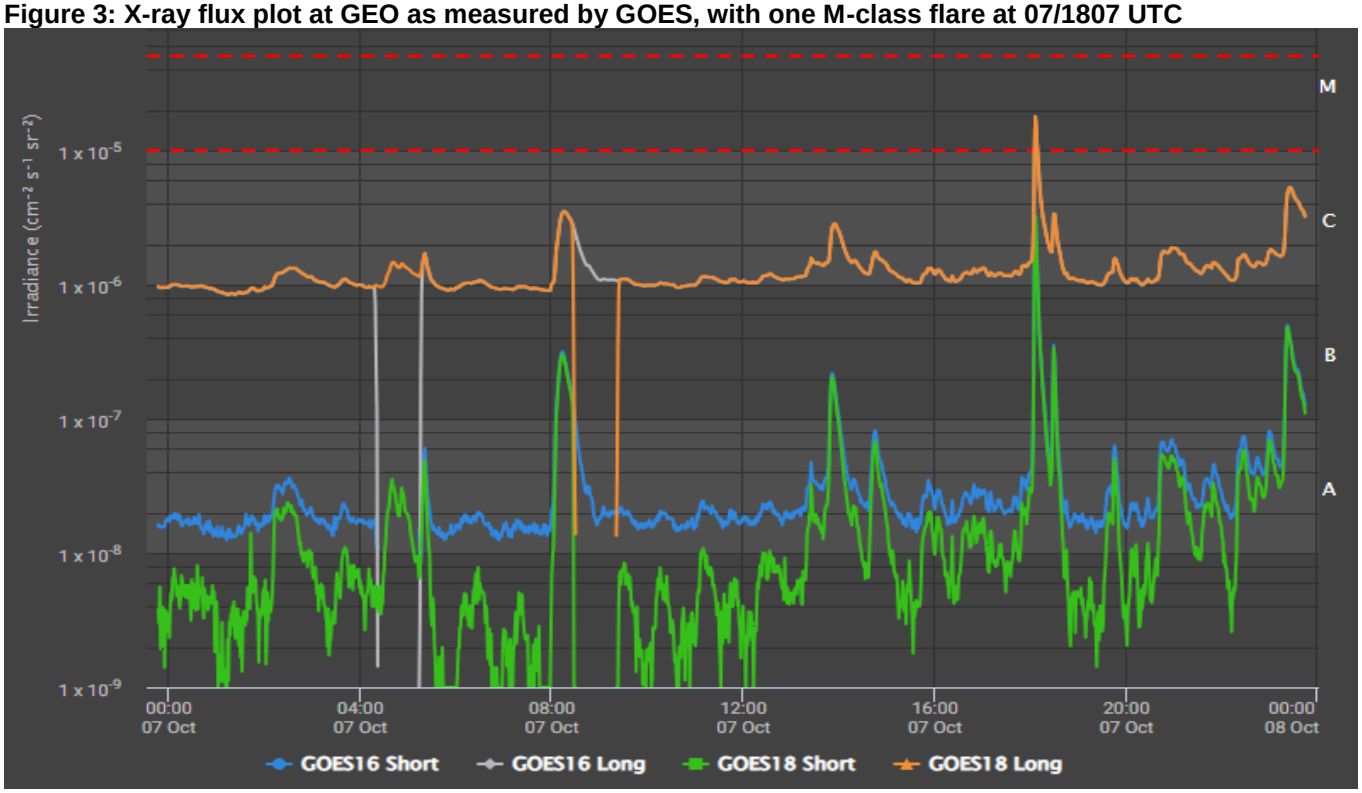
Radio Blackouts - X-Ray Flares:
Nine sunspot regions feature on the visible disc with two unnumbered. AR3451 and AR3452 in the northwest are the two largest regions. AR3451 has currently lost the delta spot in the intermediate region and the intermediate spots are showing some growth in recent hours. AR3452 is rather smaller with little overall change observed. AR3454 near south centre disc has shown minor growth recently in the trailing portion. AR3460 in the southeast is recently numbered is growing rather quickly and is north-south magnetically aligned The remaining regions all appear to be small and mostly simple at present. Far side seismographs suggest there are various regions on the far side due to rotate on in the coming days, however it is difficult to assess the likely activity of these regions until they become visible. As such, flare probabilities have been kept flat through this period. Solar activity is Moderate with a recent M-class flare from new emerged active region 3460 in the southeast, peaking at M1.7 at 07/1806UTC. Low to moderate solar activity is expected to continue, with a 30% chance of further M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: X-ray flux plot at GEO as measured by GOES, with one M-class flare at 07/1807 UTC



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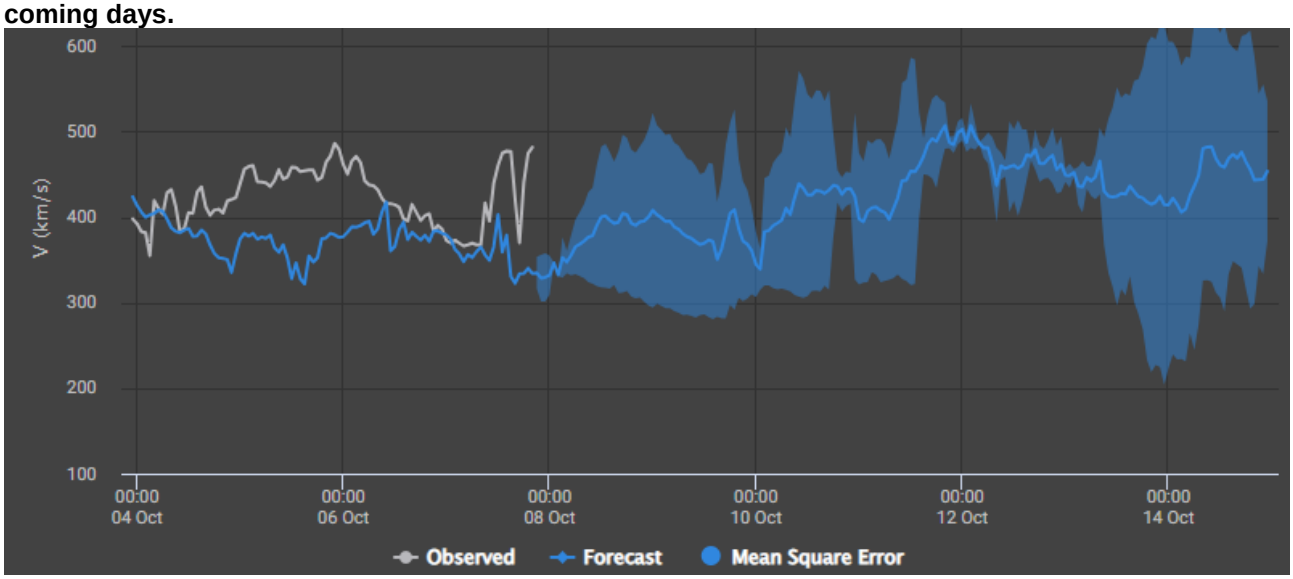
Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at background levels. The main risk of any enhancement is from AR3451 and AR3452, which are both comfortably in the western hemisphere, which offers an enhanced risk.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office Solr Winds Prediction Model (SWPM), showing probable enhanced levels in coming days.



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High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES16 has achieved moderate levels at the diurnal maximum in recent days. This is expected to continue through the period, with a slight chance of briefly reaching High levels during the diurnal max. The potential CME shock and HSS effects on Day 2 (09 Oct) could potentially lead to a degree of temporary suppression in the flux but activity is likely to be raised again for the end of this four day guidance period..
Electron fluence is forecast to be well below the Active (1e8 integrated pfu) level throughout. MOSWOC REFM output is offering reasonable guidance with a mostly flat trend, held below Active threshold level, but levels appear to be a little too low.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux at GEO over the past three days and and corresponding fluence levels.

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